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(56) Documents Cited
EP 0569994 A2
WPI Accession No91-235535/32 & JP3154896A (Toke) 2/7/91 (see abstract) WPI Accession No90-321797/43 & DE4012278A (HITA) 18/10/90 (see abstract)

(58) Field of Search
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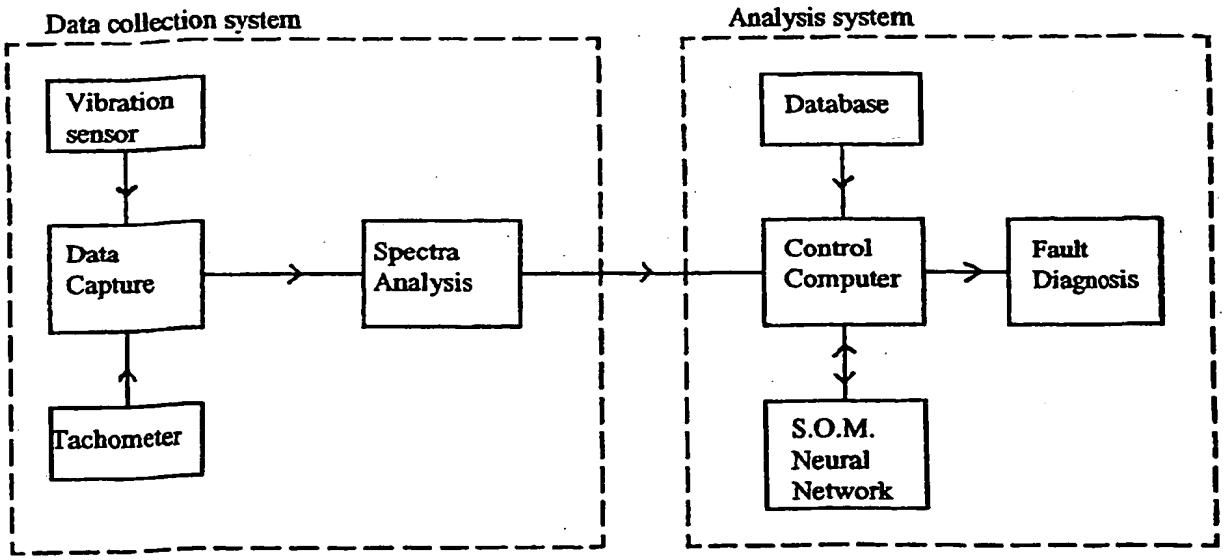
(54) Machine monitoring using neural network

(57) An automatic machine health monitoring system which combines the use of vibration analysis and self organising map neural networks to facilitate fault detection and diagnosis with training examples taken only from the machine when in a good condition. Component specification data is used to determine a set of key frequencies, the amplitudes of which are used as the input parameters of the self organising map network. The networks outputs are in the form of individual distance values from each of the key frequencies. The control computer uses this information to detect and diagnose faults in the machine under examination.

Figure 1



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NEURAL NETWORK BASED MACHINE HEALTH MONITORING SYSTEM

This invention relates to the use of neural networks in the field of machine health monitoring.

Machine health monitoring or condition monitoring of machinery is commonly carried out by vibration analysis. Vibration detecting probes are attached or placed on machine casings and the vibrations detected converted to spectral information and analysed by experts. The condition of the machine can be determined by the overall vibration level and by the level of particular vibration frequencies. These measures are taken against readings made when the machine was known to be in good condition. Analysis of individual frequency levels can by used to diagnose the fault since within the machine different components will vibrate at different frequencies. Hence using a database of component specifications and a reading of the machine speed it is possible to isolate the cause of a particular vibration. Conversely it is possible to use the specification and speed information to select key vibration frequencies to examine in order to check the condition of individual components.

A variety of neural network systems have been suggested and researched to carry out the condition monitoring and vibration analysis tasks automatically. The most suitable neural network architecture being the Self Organising Map or Kohonen Network. This network type can use frequency values as its input and train to either output a general condition value similar to the overall vibration level, or if given examples of known faults can detect the onset of that fault.

Fault identification using a neural network has the disadvantage that examples of fault conditions are required for training. This training data can only be collected if the machine to be monitored develops a fault since it is very often highly undesirable or impossible to specially run machinery with faults in order to collect example data.

According to the present invention there is provided a system which combines the use of a database of component specifications with a self organising map network to facilitate the automatic fault diagnosis from vibration spectra with only training examples taken from the vibration of the machine when known to be in a good condition.

The invention is now described with reference to the accompanying drawing in which:-

Figure 1 shows a block diagram of the main system components

Referring to figure 1 the analysis system comprises a database of either component specifications within the machine to be monitored from which a set of key frequencies (as described above) can be established by the control computer with reference to the

CLAIMS

1 A machine health monitoring system which combines the use of vibration analysis techniques and self organising map neural networks to perform fault detection and diagnosis.

2 The use of a tachometer and vibration sensors as the input devices from machinery subject to vibration to the system described in claim 1.

3 The use of vibration sensors as the input device from machinery subject to vibration, whose operating speed is constant, to the system described in claim 1.

4 The use of a separate data collection and storage system with data transfer to the analysis system described in claims 1, 2 and 3 by some telemetric link.

5 The use of dedicated data collection with data transfer to the analysis system described in claims 1, 2and 3.

6 The system illustrated in figure 1 to implement claim 1.

7 Emulations of the system described in claims 1 to 6 inclusive.

Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report)

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Relevant Technical Fields

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Search Examiner
S DAVIES

Date of completion of Search
4 JULY 1994

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE WPI

Documents considered relevant following a search in respect of Claims :-
1-7

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
A	EP 0569994 A2 (MITSUBISHI) see eg column 2, lines 12-34	
A	WPI Accession No. 91-235535/32 and JP 3154896 A (TOKE) 02.07.91 (see abstract)	
A	WPI Accession No. 90-321797/43 and DE 4012278 A (HITA) 18.10.90 (see abstract)	

Databases:The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).